

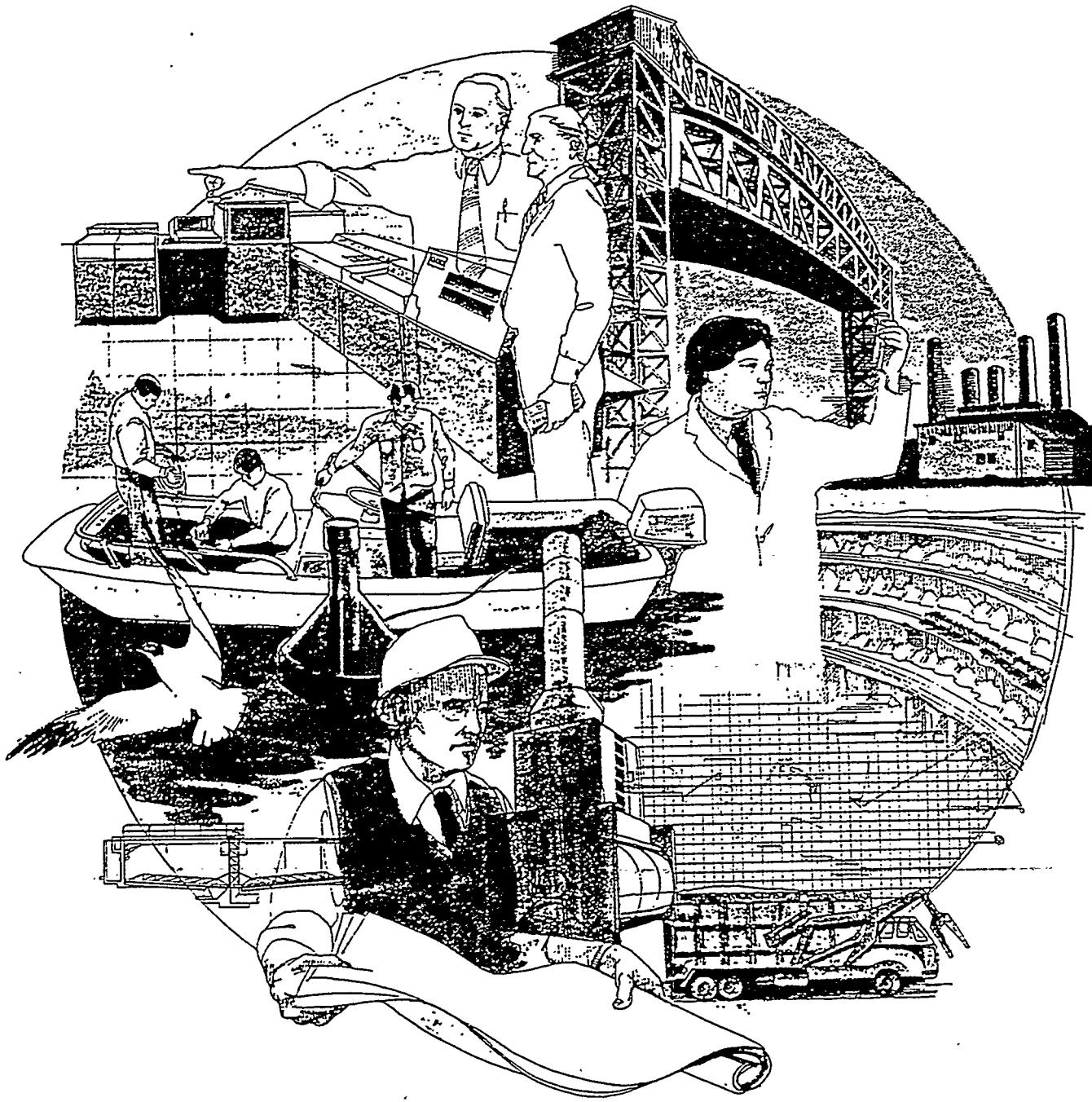


Modeling of Strontium-90 for the United Nuclear  
Corporation Waste Disposal Site,  
Oak Ridge Y-12 Plant,  
Oak Ridge, Tennessee

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Environmental Restoration Division  
Y-12 Environmental Restoration Program

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Prepared for  
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Oak Ridge Y-12 Plant  
Oak Ridge, Tennessee 37831-8169  
managed by  
MARTIN MARIETTA ENERGY SYSTEMS, INC.  
for the  
U.S. DEPARTMENT OF ENERGY  
under contract DE-AC05-84OR21400

**MODELING OF STRONTIUM-90  
FOR THE UNITED NUCLEAR CORPORATION WASTE DISPOSAL SITE  
OAK RIDGE Y-12 PLANT, OAK RIDGE, TENNESSEE**

This report presents the results of hydrologic impact modeling for Sr-90 migration at the United Nuclear Corporation (UNC) Waste Disposal Site at the Oak Ridge Y-12 Plant, as a second addendum to the baseline condition report for this site prepared previously ("Pathways Analysis for the UNC Disposal Pit", 30 December 1986). This addendum should be distributed only to those individuals who received the original report or should be accompanied by the original report and the previous addendum in the event of new distributions. This addendum includes brief descriptions of the methodology used as well as figures, calculations, and simulation output. Detailed descriptions of the simulation methodology and site conditions are provided in the previous report.

The HELP and SOLUTE-WMPLUME simulations presented in the UNC Waste Disposal Site baseline evaluation ("Pathways Analysis for the UNC Disposal Pit", 30 December 1986) have been applied to two closure alternatives selected by Martin Marietta Energy Systems, Inc. These alternatives are: 1) a no action alternative as described in the baseline report; and 2) a RCRA-type multilayered cap consisting of a compacted clay layer, synthetic liner, horizontal drainage layer, and a limited topsoil cover placed over the wastes. Cross-sections depicting the details of the RCRA-type cap are provided in the first addendum ("Results of Computer Simulations for Alternative Closure Options; UNC Disposal Pit", 27 February 1987).

Data derived from the HELP model runs in both the baseline report and the February 1987 addendum were used to generate source-strength calculations for Sr-90. The baseline water budget data are derived from the original report; and the water budget data for the RCRA-type cap are from the 1987 addendum. These data were used in this study to estimate the source strength of the Sr-90 in the UNC waste, which is a key input parameter needed to run the WMPLUME model simulation.

The WMPLUME model was run to simulate a period of 30 years after the Sr-90 had infiltrated down to the water table. The infiltration time is estimated to be 10 years for the no action alternative and 87 years for the RCRA-type cap alternative. This infiltration delay is not taken into account for this study, so that the Sr-90 is assumed to reach the

groundwater immediately upon being released. This is a conservative assumption since the Sr-90, which has a radiological half life of approximately 28.6 years, would decay during this infiltration period, resulting in an additional decrease in the source strength. The 30 year time interval for the model runs was chosen because the highest Sr-90 concentrations should occur during that time period. Radioactive decay would only decrease the source strength over a longer time period.

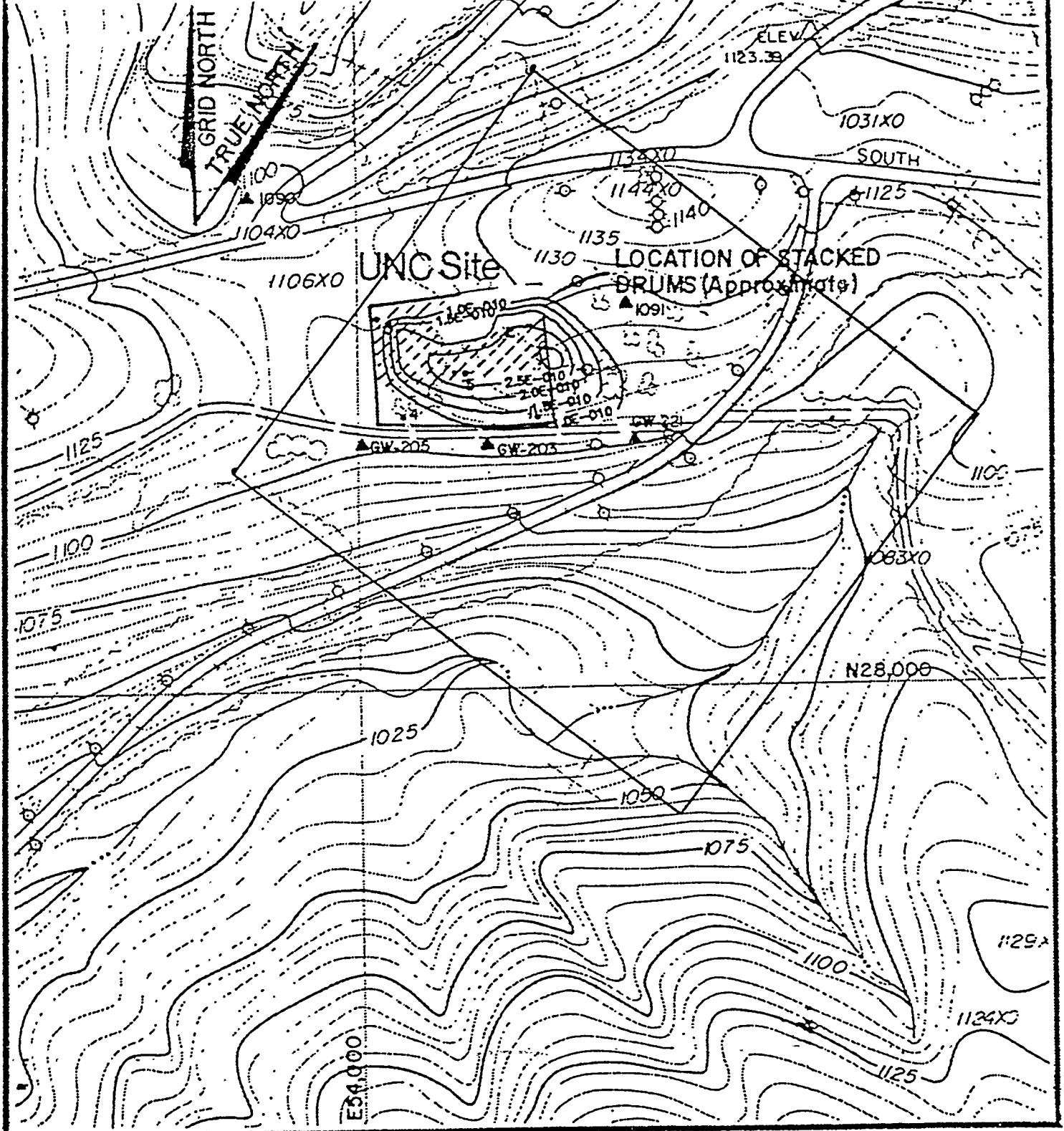
The results of the simulations are provided below:

| <u>Alternative</u> | <u>Infiltration (ft<sup>3</sup>)</u> | Estimated<br>Maximum Sr-90<br>Concentration in<br><u>Groundwater</u> |                | Estimated<br>Annual Sr-90<br>Load in<br><u>Runoff</u> |                      |
|--------------------|--------------------------------------|--|----------------|---|----------------------|
|                    |                                      | <u>(mg/L)</u>  | <u>(pCi/L)</u> | <u>(g)</u>  | <u>(Ci)</u>          |
| No Action          | 39,700                               | $3.5 \times 10^{-10}$  | 50             | $5.8 \times 10^{-7}$                                  | $8.2 \times 10^{-5}$ |
| RCRA cap           | 4,800                                | $1.5 \times 10^{-11}$  | 2              | 0   | 0                    |

Figures 1 and 2 depict the contaminant plume predicted by the WMPLUME simulation for the no action alternative and the RCRA-type cap alternative, respectively. It should be noted that the proposed maximum contaminant level (MCL) of 50 pCi/L( $3.5 \times 10^{-10}$  mg/L) was exceeded only in a very small portion of the site, as shown in Figure 1 (no action alternative). The MCL value represents the concentration in drinking water that would yield a risk equal to that from a dose rate of 4 mrem/year. The WMPLUME model also predicts that the  $3.5 \times 10^{-10}$  mg/L (50 pCi/L) isopleth never intersects the stream that flows to the southeast of the pit. The MCL for Sr-90 was not exceeded in the RCRA cap scenario.

The numerical values predicted by the these simulations are estimates which are limited by the availability and suitability of the model input data and the applicability of the models themselves. However, the values can be used to provide an indication of the relative effectiveness of the closure alternatives considered. In both cases, the simulations are based upon very conservative assumptions, and actual concentrations would very likely be much smaller. In particular, the radiological decay of the source strength over time was not considered, infiltrating water was assumed to reach the groundwater immediately, and a relatively low retardation coefficient was assumed for Sr-90 migration in groundwater.

Input and output data associated with the models and supporting calculations follow.



SOURCES: GRADING SITE PLAN, UCC-ND DRAWING NO. C2E-109322 (1982); BOREHOLE LOCATION MAP, MARTIN MARIETTA ENEP/SY SYSTEMS, INC., SHEET 3 OF 9 (1986); AND UNREFERENCED 1"=200' TOPOGRAPHIC MAP OF THE Y-12 PLANT AREA.  
SCALE: 1"= 200'

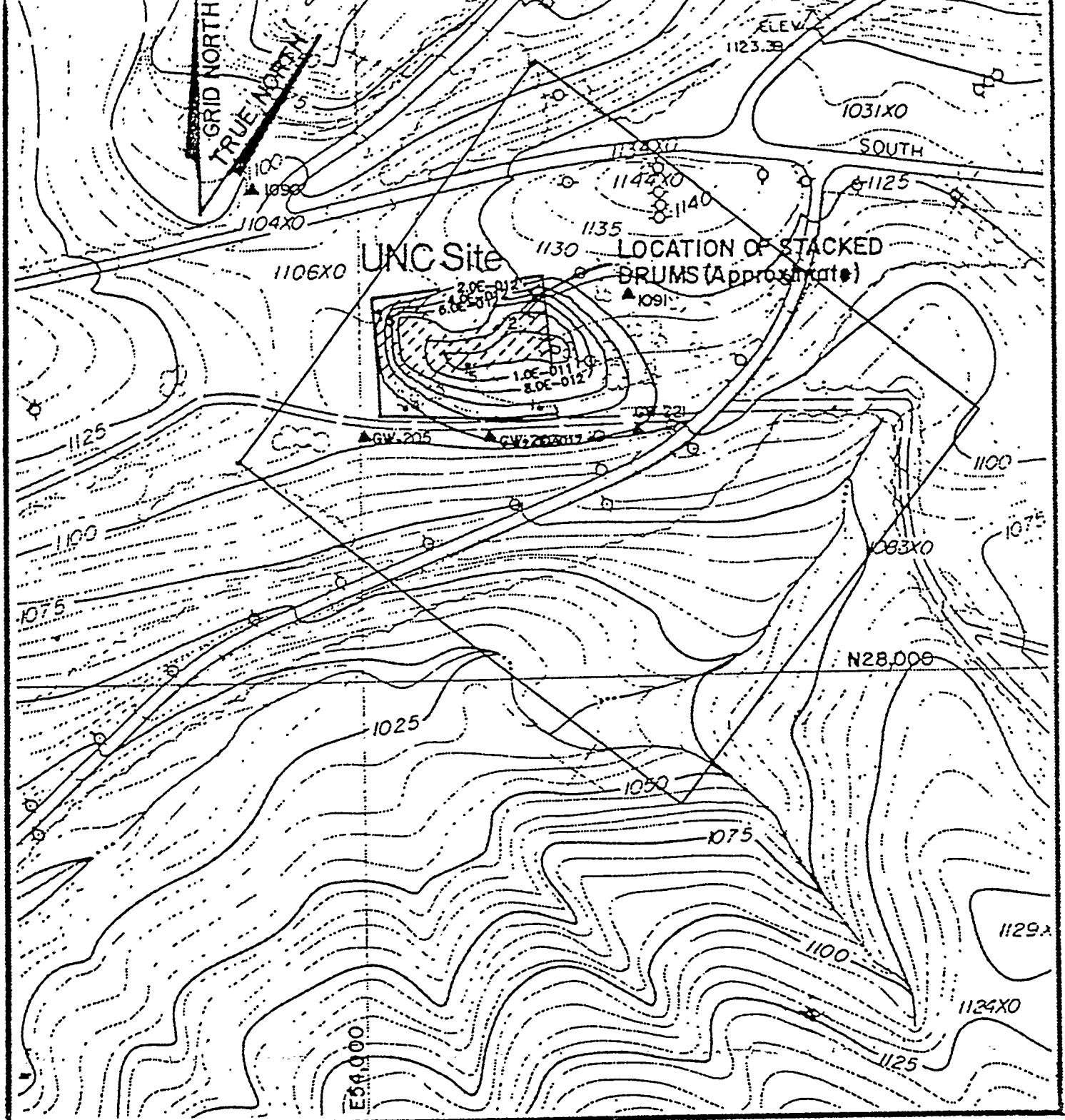
LEGEND: ▲ GROUNDWATER MONITORING WELLS (LOCATIONS APPROXIMATE)

• BORINGS CONDUCTED BY GEOTEK, 1982 (LOCATIONS APPROXIMATE)

**Figure 1**

### No Action Alternative

### **Estimated Sr-90 Concentrations (mg/D)**



SOURCES: GRADING SITE PLAN, UCC-ND DRAWING NO. C2E-109322 (1982); BOREHOLE LOCATION MAP, MARTIN MARIETTA ENERGY SYSTEMS, INC. SHEET 3 OF 9 (1986); AND UNREFERENCED 1"=200' TOPOGRAPHIC MAP OF THE Y-12 PLANT AREA.  
SCALE: 1" = 200'

LEGEND: ▲ GROUNDWATER MONITORING WELLS (LOCATIONS APPROXIMATE)  
• BORINGS CONDUCTED BY GEOTEK, 1982 (LOCATIONS APPROXIMATE)

**Figure 2**

**RCRA Type Cap Alternative**  
**Estimated Sr-90 Concentrations (mg/D)**

## I. HELP MODEL

## UNC SITE SIMULATION

(NOTE: See Sections 4.1.1 and 4.3.1 of "Pathways Analysis of the UNC Disposal Pit", (30 December 1986) for description of the model and discussion of user-specified input.)

### A. SIMULATION INPUT

#### LAYER 1

|                                    |                   |
|------------------------------------|-------------------|
| WASTE LAYER                        |                   |
| ** THICKNESS                       | = .10 INCHES      |
| * EVAPORATION COEFFICIENT          | = 3.9 MM/DAY**0.5 |
| * POROSITY                         | = .582 VOL/VOL    |
| * FIELD CAPACITY                   | = .452 VOL/VOL    |
| * WILTING POINT                    | = .325 VOL/VOL    |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = .065 INCHES/HR  |

#### LAYER 2

|                                    |                   |
|------------------------------------|-------------------|
| VERTICAL PERCOLATION LAYER         |                   |
| ** THICKNESS                       | = 540.00 INCHES   |
| * EVAPORATION COEFFICIENT          | = 3.9 MM/DAY**0.5 |
| * POROSITY                         | = .582 VOL/VOL    |
| * FIELD CAPACITY                   | = .452 VOL/VOL    |
| * WILTING POINT                    | = .325 VOL/VOL    |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = .065 INCHES/HR  |

#### GENERAL SIMULATION DATA

|                                     |                   |
|-------------------------------------|-------------------|
| ** SCS RUNOFF CURVE NUMBER          | = 91.00           |
| ** TOTAL AREA OF COVER              | = 31000. SQ. FT   |
| * EVAPORATIVE ZONE DEPTH            | = 4.00 INCHES     |
| * POTENTIAL RUNOFF FRACTION         | = .75             |
| * EFFECTIVE EVAPORATION COEFFICIENT | = 3.9 MM/DAY**0.5 |
| * UPPER LIMIT VEG. STORAGE          | = 2.32 INCHES     |
| * INITIAL VEG. STORAGE              | = 1.55 INCHES     |

\* DEFAULT DATA

\*\* USER SPECIFIED DATA

## CLIMATOLOGIC DATA

### DEFAULT MONTHLY MEAN TEMPERATURES, DEGREES FAHRENHEIT

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---------|---------|---------|---------|---------|---------|
| 40.12   | 42.52   | 49.52   | 59.25   | 69.10   | 76.44   |
| 79.30   | 76.90   | 69.90   | 60.17   | 50.31   | 42.97   |

### DEFAULT MONTHLY MEANS SOLAR RADIATION, LANGLEYS PER DAY

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---------|---------|---------|---------|---------|---------|
| 179.83  | 237.55  | 329.06  | 429.84  | 512.89  | 555.96  |
| 547.50  | 489.79  | 398.28  | 297.50  | 214.44  | 171.38  |

### B. SIMULATION OUTPUT

#### AVERAGE ANNUAL TOTALS

|                                   | (INCHES) | (CU. FT.) | PERCENT |
|-----------------------------------|----------|-----------|---------|
| PRECIPITATION                     | 52.30    | 135108.   | 100.00  |
| RUNOFF                            | 8.00     | 20729.    | 15.34   |
| EVAPOTRANSPIRATION                | 27.90    | 72298.    | 53.51   |
| PERCOLATION FROM BASE OF LANDFILL | 15.30    | 39651.    | 29.35   |

L WATER BUDGET/SOURCE STRENGTH CALCULATIONS  
NO ACTION ALTERNATIVE

A. Water Budget Estimates for UNC Site  
(from HELP model, Section I.B. of UNC Site Simulation)

|                    | <u>Inches</u> | <u>Ft<sup>3</sup></u> |
|--------------------|---------------|-----------------------|
| Precipitation      | 52.3          | 135,000               |
| Runoff             | 8.0           | 20,700                |
| Evapotranspiration | 27.9          | 72,300                |
| Percolation        | 15.3          | 39,700                |

B. Source Strength/Inventory Calculations

1. Using data from 1986 Report (Table 8), for strontium in sludges/soils.

$$(6.2 \text{ dpm/g})(29,000 \text{ drums})(320 \text{ kg/drum})(10^3 \text{ g/kg})/(3.7 \times 10^{10} \text{ dps/Ci} \times 60 \text{ sec/min})$$

$$\begin{aligned} &= 0.026 \text{ Ci Sr-90} \\ &= 26 \text{ mCi Sr-90} \end{aligned}$$

$$\begin{aligned} \text{g: } (0.026 \text{ Ci})/(141 \text{ Ci/g}) &= 1.84 \times 10^{-4} \text{ g Sr-90} \\ \text{lb: } (1.84 \times 10^{-4} \text{ g})/(453.5924 \text{ g/lb}) &= 4.07 \times 10^{-7} \text{ lb Sr-90} \end{aligned}$$

2. Using data from 1986 Report (Table 8) for Sr-90 in EP-tox leachate:

$$(0.18 \text{ dpm/ml})(20 \text{ ml/g})(29,000 \text{ drums})(320 \text{ kg/drum})(10^3 \text{ g/kg})/(3.7 \times 10^{10} \text{ dps/Ci} \times 60 \text{ sec/min})$$

$$\begin{aligned} &= 0.015 \text{ Ci Sr-90} \\ &= 15 \text{ mCi Sr-90} \end{aligned}$$

$$\begin{aligned} \text{g: } (0.015 \text{ Ci})/(141 \text{ Ci/g}) &= 1.07 \times 10^{-4} \text{ g Sr-90} \\ \text{lb: } (1.07 \times 10^{-4} \text{ g})/(453.5924 \text{ g/lb}) &= 2.35 \times 10^{-7} \text{ lb Sr-90} \end{aligned}$$

Therefore, higher inventory estimate from B.1 will be used in subsequent calculations.

C. Annual Sr-90 Released

Sr-90 concentration in infiltrating water:

$$(0.31 \text{ dpm/ml})/(3.7 \times 10^{10} \text{ dps/Ci} \times 60 \text{ sec/min})(10^3 \text{ ml/l})(28.32 \text{ l/ft}^3)$$

$$\begin{aligned} &= 3.95 \times 10^{-9} \text{ Ci/ft}^3 \\ &= (3.95 \times 10^{-9} \text{ Ci/ft}^3)/(141 \text{ Ci/g}) = 2.8 \times 10^{-11} \text{ g/ft}^3 \end{aligned}$$

Annual Release:

$$\begin{aligned} & (135,000 \text{ ft}^3/\text{yr percolation})(2.8 \times 10^{-11} \text{ g}/\text{ft}^3) \\ & = 3.8 \times 10^{-6} \text{ g Sr-90 released/year} \\ & = 5.3 \times 10^{-4} \text{ Ci Sr-90 released/year} \end{aligned}$$

D. Annual Surface Runoff Sr-90 Local

$$\begin{aligned} & (20,700 \text{ ft}^3 \text{ runoff}/135,000 \text{ ft}^3 \text{ precip})(3.8 \times 10^{-6} \text{ g}) & = 5.8 \times 10^{-7} \text{ g/yr Sr-90} \\ & \text{or} \\ & (20,700 \text{ ft}^3 \text{ runoff}/135,000 \text{ ft}^3 \text{ precip})(5.3 \times 10^{-4} \text{ Ci}) & = 8.1 \times 10^{-5} \text{ Ci/yr Sr-90} \end{aligned}$$

E. Annual Percolation Sr-90 Load

Assuming all Sr-90 in evapotranspiration fraction ultimately percolates:

$$\begin{aligned} & 3.8 \times 10^{-6} \text{ g/yr release} - 5.8 \times 10^{-7} \text{ g/yr runoff} = 3.2 \times 10^{-6} \text{ g/yr Sr-90} & = 8.8 \times 10^{-9} \text{ g/day} \\ & & = 1.9 \times 10^{-11} \text{ lb/day} \\ & \text{or} \\ & 5.3 \times 10^{-4} \text{ Ci/yr} - 8.1 \times 10^{-5} \text{ Ci/yr} & = 4.5 \times 10^{-4} \text{ Ci/yr Sr-90} & = 1.2 \times 10^{-6} \text{ Ci/day} \end{aligned}$$

F. Years required to release total inventory.

$$(26 \text{ mCi})/(0.53 \text{ mCi/yr}) = 50 \text{ years}$$

G. Years Required to Reach Groundwater

For water:

$$\begin{aligned} & (15.3 \text{ in/year percolation})/(0.3 \text{ effective porosity}) = 51 \text{ inches annual depth of percolation} \\ & (45 \text{ ft soil thickness})(12 \text{ in/ft})/(51 \text{ in/year}) = 10.6 \text{ years} \end{aligned}$$

For Sr-90:

Assuming Sr-90 Retardation Factor = 40

$$10.6 \text{ years} \times 40 = 424 \text{ years}$$

(= 15 half-lives of Sr-90; typically 10 half-lives yield negligible activity.)

H. Source Strength Used for WMPLUME

Assuming 10 point sources spaced evenly over the UNC site:

$$\begin{aligned} \text{Source Strength} & = 1.2 \times 10^{-6} \text{ Ci/day}/10 & = 1.2 \times 10^{-7} \text{ Ci/day} \\ & = 8.8 \times 10^{-9} \text{ g/day}/10 & = 8.8 \times 10^{-10} \text{ g/day} \\ & = 1.9 \times 10^{-11} \text{ lb/day}/10 & = 1.9 \times 10^{-12} \text{ lb/day Sr-90 per source} \end{aligned}$$

## Physical/Chemical Parameters for Sr-90

1. Half-Life = 28.6 years (Kocher, 1981)
2. Specific Activity = 141 Ci/g (The Health Physics and Radiological Health Handbook, 1984)
3. Distribution Coefficient ( $K_d$ )
  - a. Generic Estimate (Baes et al. 1984)  
Geometric Mean = 37 ml/g  
Range = 0.15 to 3,300 ml/g
  - b. Estimate for UNC waste analysis (Pathways Analysis for the UNC Disposal Pit, 30 December 1986)

$$K_d = 43 \text{ ml/g}$$

Assume 40 ml/g for this analysis.

\*\*\*\*\*  
\*  
\* SOLUTE TRANSPORT FROM POINT SOURCES \*  
\* IN TWO-DIMENSIONAL UNIFORM FLOW \*  
\*  
\* MODEL: WMPLUME \*  
\*  
\*\*\*\*\*

USER: **No Action Alternative**

LOCATION:

-----

DATE:

-----

INPUT DATA:

|                                |       |      |
|--------------------------------|-------|------|
| DARCY VELOCITY.....            | 0.14  | ft/d |
| EFFECTIVE POROSITY.....        | .15   |      |
| AQUIFER THICKNESS.....         | 20.00 | ft   |
| LONGITUDINAL DISPERSIVITY..... | 12.00 | ft   |
| LATERAL DISPERSIVITY.....      | 4.00  | ft   |
| RETARDATION FACTOR.....        | 50.00 |      |
| DECAY CONSTANT (lambda).....   | .0001 | 1/d  |
| NUMBER OF POINT SOURCES.....   | 10    |      |

SOURCE DATA:

SOURCE NO. 1

-----

|   |          |      |
|---|----------|------|
| X-COORDINATE OF THE SOURCE.....         | 40.00    | ft   |
| Y-COORDINATE OF THE SOURCE.....         | 640.00   | ft   |
| THE SOURCE STRENGTH.....                | 1.90E-12 | lb/d |
| ELAPSED TIME OF THE SOURCE ACTIVITY.... | 10950.00 | d    |

SOURCE NO. 2

-----

|   |          |      |
|---|----------|------|
| X-COORDINATE OF THE SOURCE.....         | 80.00    | ft   |
| Y-COORDINATE OF THE SOURCE.....         | 600.00   | ft   |
| THE SOURCE STRENGTH.....                | 1.90E-12 | lb/d |
| ELAPSED TIME OF THE SOURCE ACTIVITY.... | 10950.00 | d    |

SOURCE NO. 3

---

X-COORDINATE OF THE SOURCE.....: 80.00 ft  
Y-COORDINATE OF THE SOURCE.....: 680.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 4

---

X-COORDINATE OF THE SOURCE.....: 120.00 ft  
Y-COORDINATE OF THE SOURCE.....: 640.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 5

---

X-COORDINATE OF THE SOURCE.....: 120.00 ft  
Y-COORDINATE OF THE SOURCE.....: 720.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 6

---

X-COORDINATE OF THE SOURCE.....: 160.00 ft  
Y-COORDINATE OF THE SOURCE.....: 680.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 7

---

X-COORDINATE OF THE SOURCE.....: 160.00 ft  
Y-COORDINATE OF THE SOURCE.....: 760.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 8

---

X-COORDINATE OF THE SOURCE.....: 200.00 ft  
Y-COORDINATE OF THE SOURCE.....: 720.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 9

---

X-COORDINATE OF THE SOURCE.....: 200.00 ft  
Y-COORDINATE OF THE SOURCE.....: 800.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 10

X-COORDINATE OF THE SOURCE.....: 240.00 ft  
Y-COORDINATE OF THE SOURCE.....: 750.00 ft  
THE SOURCE STRENGTH.....: 1.90E-12 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...: 10950.00 d

GRID DATA:

X-COORDINATE OF THE GRID ORIGIN.....: 0.00 ft  
Y-COORDINATE OF THE GRID ORIGIN.....: 340.00 ft  
DISTANCE INCREMENT DELX.....: 30.00 ft  
DISTANCE INCREMENT DELY.....: 30.00 ft  
NUMBER OF NODES IN X-DIRECTION.....: 27  
NUMBER OF NODES IN Y-DIRECTION.....: 25

----- X-direction

## CONCENTRATION in mg/l (ppm)

|         |    | 0.00 ft  | 30.00 ft | 60.00 ft    | 90.00 ft    | 120.00 ft    |
|---------|----|----------|----------|-------------|-------------|--------------|
| 340.00  | ft | 0.00E+00 | 0.00E+00 | 6813.47E-29 | 5961.54E-26 | 1770.12E-25  |
| 370.00  | ft | 0.00E+00 | 0.00E+00 | 1587.44E-26 | 7110.43E-24 | 2104.06E-23  |
| 400.00  | ft | 0.00E+00 | 0.00E+00 | 2230.08E-24 | 5208.43E-22 | 1532.67E-21  |
| 430.00  | ft | 0.00E+00 | 0.00E+00 | 1906.50E-22 | 2411.49E-20 | 7028.73E-20  |
| 460.00  | ft | 0.00E+00 | 0.00E+00 | 1014.39E-20 | 7389.45E-19 | 2117.28E-18  |
| 490.00  | ft | 0.00E+00 | 0.00E+00 | 3485.78E-19 | 1609.89E-17 | 4467.60E-17  |
| 520.00  | ft | 0.00E+00 | 0.00E+00 | 8217.24E-18 | 2765.05E-16 | 7196.88E-16  |
| 550.00  | ft | 0.00E+00 | 0.00E+00 | 1459.50E-16 | 4280.34E-15 | 9590.26E-15  |
| 580.00  | ft | 0.00E+00 | 0.00E+00 | 2217.20E-15 | 7240.31E-14 | 9671.37E-14  |
| 610.00  | ft | 0.00E+00 | 0.00E+00 | 3290.51E-14 | 2398.46E-13 | 2170.23E-13  |
| 640.00  | ft | 0.00E+00 | 0.00E+00 | 2922.35E-13 | 1779.45E-13 | -1000.00E-03 |
| 670.00  | ft | 0.00E+00 | 0.00E+00 | 3290.51E-14 | 2398.46E-13 | 2196.78E-13  |
| 700.00  | ft | 0.00E+00 | 0.00E+00 | 2217.20E-15 | 7240.31E-14 | 1453.44E-13  |
| 730.00  | ft | 0.00E+00 | 0.00E+00 | 1459.50E-16 | 4280.34E-15 | 1642.91E-13  |
| 760.00  | ft | 0.00E+00 | 0.00E+00 | 8217.24E-18 | 2765.05E-16 | 7478.10E-15  |
| 790.00  | ft | 0.00E+00 | 0.00E+00 | 3485.78E-19 | 1609.89E-17 | 4725.63E-16  |
| 820.00  | ft | 0.00E+00 | 0.00E+00 | 1014.39E-20 | 7389.45E-19 | 2864.67E-17  |
| 850.00  | ft | 0.00E+00 | 0.00E+00 | 1906.50E-22 | 2411.49E-20 | 1432.96E-18  |
| 880.00  | ft | 0.00E+00 | 0.00E+00 | 2230.08E-24 | 5208.43E-22 | 5270.26E-20  |
| 910.00  | ft | 0.00E+00 | 0.00E+00 | 1587.44E-26 | 7110.43E-24 | 1311.73E-21  |
| 940.00  | ft | 0.00E+00 | 0.00E+00 | 6813.47E-29 | 5961.54E-26 | 2092.53E-23  |
| 970.00  | ft | 0.00E+00 | 0.00E+00 | 1781.76E-31 | 3022.78E-28 | 2067.71E-25  |
| 1000.00 | ft | 0.00E+00 | 0.00E+00 | 2948.64E-34 | 9288.00E-31 | 1240.35E-27  |
| 1030.00 | ft | 0.00E+00 | 0.00E+00 | 5303.22E-37 | 1777.80E-33 | 4495.36E-30  |
| 1060.00 | ft | 0.00E+00 | 0.00E+00 | 2739.10E-40 | 2245.55E-36 | 1002.35E-32  |

|         |    | 150.00 ft   | 180.00 ft   | 210.00 ft   | 240.00 ft    | 270.00 ft   |
|---------|----|-------------|-------------|-------------|--------------|-------------|
| 340.00  | ft | 4333.05E-25 | 8750.25E-25 | 1458.94E-24 | 2010.42E-24  | 2292.47E-24 |
| 370.00  | ft | 5116.28E-23 | 1023.47E-22 | 1686.52E-22 | 2292.78E-22  | 2575.86E-22 |
| 400.00  | ft | 3687.59E-21 | 7269.47E-21 | 1176.86E-20 | 1568.78E-20  | 1726.61E-20 |
| 430.00  | ft | 1661.19E-19 | 3196.72E-19 | 5030.80E-19 | 6505.93E-19  | 6945.66E-19 |
| 460.00  | ft | 4848.37E-18 | 8949.89E-18 | 1343.92E-17 | 1656.60E-17  | 1689.52E-17 |
| 490.00  | ft | 9646.27E-17 | 1652.68E-16 | 2291.86E-16 | 2618.10E-16  | 2495.75E-16 |
| 520.00  | ft | 1384.82E-15 | 2070.38E-15 | 2514.68E-15 | 2560.92E-15  | 2226.04E-15 |
| 550.00  | ft | 1450.45E-14 | 1705.83E-14 | 1702.21E-14 | 1498.38E-14  | 1176.58E-14 |
| 580.00  | ft | 8926.13E-14 | 7666.57E-14 | 6350.39E-14 | 5008.87E-14  | 3692.82E-14 |
| 610.00  | ft | 1903.00E-13 | 1639.46E-13 | 1338.67E-13 | 1040.00E-13  | 7637.00E-14 |
| 640.00  | ft | 3553.17E-13 | 2596.15E-13 | 2055.09E-13 | 1615.91E-13  | 1218.43E-13 |
| 670.00  | ft | 1973.82E-13 | 3629.71E-13 | 2850.96E-13 | 2216.17E-13  | 1703.88E-13 |
| 700.00  | ft | 1766.28E-13 | 2421.67E-13 | 2892.75E-13 | 2713.31E-13  | 2219.70E-13 |
| 730.00  | ft | 1842.41E-13 | 1750.31E-13 | 3540.46E-13 | 3097.89E-13  | 2632.91E-13 |
| 760.00  | ft | 1823.70E-14 | 3194.99E-13 | 2085.67E-13 | -1000.00E-03 | 3803.96E-13 |
| 790.00  | ft | 1328.12E-15 | 3557.67E-14 | 2438.87E-13 | 2219.32E-13  | 1953.02E-13 |
| 820.00  | ft | 8521.06E-17 | 2412.22E-15 | 7275.07E-14 | 9721.02E-14  | 8984.34E-14 |
| 850.00  | ft | 4387.66E-18 | 1566.41E-16 | 4301.13E-15 | 9622.93E-15  | 1454.65E-14 |
| 880.00  | ft | 1639.54E-19 | 8630.02E-18 | 2773.46E-16 | 7210.85E-16  | 1386.72E-15 |
| 910.00  | ft | 4117.06E-21 | 3591.31E-19 | 1612.10E-17 | 4471.39E-17  | 9651.61E-17 |
| 940.00  | ft | 6601.07E-23 | 1031.48E-20 | 7393.09E-19 | 2117.92E-18  | 4849.29E-18 |
| 970.00  | ft | 6542.12E-25 | 1923.56E-22 | 2411.86E-20 | 7029.38E-20  | 1661.29E-19 |
| 1000.00 | ft | 3931.70E-27 | 2240.37E-24 | 5208.66E-22 | 1532.71E-21  | 3687.65E-21 |
| 1030.00 | ft | 1427.00E-29 | 1591.19E-26 | 7110.51E-24 | 2104.07E-23  | 5116.30E-23 |
| 1060.00 | ft | 3186.89E-32 | 6821.88E-29 | 5961.55E-25 | 1770.13E-25  | 4333.05E-25 |

|         |    | 600.00 ft   | 630.00 ft   | 660.00 ft   | 690.00 ft   | 720.00 ft   |
|---------|----|-------------|-------------|-------------|-------------|-------------|
| 340.00  | ft | 7325.77E-29 | 1121.21E-29 | 1529.05E-30 | 1982.72E-31 | 2121.71E-32 |
| 370.00  | ft | 5943.80E-27 | 8521.38E-28 | 1079.69E-28 | 1225.88E-29 | 1265.63E-30 |
| 400.00  | ft | 7065.20E-25 | 4193.78E-26 | 5035.17E-27 | 5381.24E-28 | 5198.03E-29 |
| 430.00  | ft | 9848.33E-24 | 1312.09E-24 | 1526.76E-25 | 1573.83E-26 | 1459.85E-27 |
| 460.00  | ft | 1978.72E-22 | 2628.86E-23 | 3046.59E-24 | 3122.07E-25 | 2872.51E-26 |
| 490.00  | ft | 2574.98E-21 | 5515.62E-22 | 4197.13E-23 | 4435.03E-24 | 4204.53E-25 |
| 520.00  | ft | 2328.77E-20 | 3385.75E-21 | 4322.90E-22 | 4892.37E-23 | 4960.31E-24 |
| 550.00  | ft | 1605.56E-19 | 2569.12E-20 | 3620.62E-21 | 4520.92E-22 | 5037.20E-23 |
| 580.00  | ft | 9150.40E-19 | 1644.92E-19 | 2605.20E-20 | 3645.11E-21 | 4524.50E-22 |
| 610.00  | ft | 4501.63E-18 | 9147.37E-19 | 1634.67E-19 | 2568.88E-20 | 3554.04E-21 |
| 640.00  | ft | 1922.17E-17 | 4385.82E-18 | 8760.30E-19 | 1527.44E-19 | 2320.71E-20 |
| 670.00  | ft | 6899.96E-17 | 1730.25E-17 | 3768.97E-18 | 7098.77E-19 | 1152.28E-19 |
| 700.00  | ft | 1929.04E-16 | 5143.85E-17 | 1182.31E-17 | 2330.83E-18 | 3927.46E-19 |
| 730.00  | ft | 3786.06E-16 | 1040.37E-16 | 2452.97E-17 | 4938.66E-18 | 8462.15E-19 |
| 760.00  | ft | 4779.55E-16 | 1325.44E-16 | 3148.77E-17 | 6378.24E-18 | 1098.06E-18 |
| 790.00  | ft | 3735.81E-16 | 1031.30E-16 | 2439.05E-17 | 4920.49E-18 | 8441.90E-19 |
| 820.00  | ft | 1831.12E-16 | 4965.99E-17 | 1154.88E-17 | 2294.91E-18 | 3887.37E-19 |
| 850.00  | ft | 5825.41E-17 | 1535.02E-17 | 3467.80E-18 | 6704.22E-19 | 1108.25E-19 |
| 880.00  | ft | 1217.04E-17 | 3115.86E-18 | 6814.17E-19 | 1273.64E-19 | 2038.14E-20 |
| 910.00  | ft | 1626.04E-18 | 4091.54E-19 | 8742.41E-20 | 1590.25E-20 | 2472.98E-21 |
| 940.00  | ft | 1335.35E-19 | 3348.72E-20 | 7096.25E-21 | 1275.74E-21 | 1957.35E-22 |
| 970.00  | ft | 5550.91E-21 | 1654.84E-21 | 3525.51E-22 | 5367.39E-23 | 9821.24E-24 |
| 1000.00 | ft | 1896.35E-22 | 4864.96E-23 | 1053.50E-23 | 1940.53E-24 | 3063.06E-25 |
| 1030.00 | ft | 5245.91E-24 | 8527.49E-25 | 1899.82E-25 | 3617.31E-26 | 5942.70E-27 |
| 1060.00 | ft | 5337.70E-26 | 9075.80E-27 | 2106.85E-27 | 4211.92E-28 | 7325.38E-29 |

### 750.00 ft      780.00 ft

|         |    |             |             |
|---------|----|-------------|-------------|
| 340.00  | ft | 2218.35E-33 | 2180.56E-34 |
| 370.00  | ft | 1205.91E-31 | 1076.09E-32 |
| 400.00  | ft | 4611.03E-30 | 3816.31E-31 |
| 430.00  | ft | 1238.71E-28 | 9775.68E-30 |
| 460.00  | ft | 2411.50E-27 | 1877.61E-28 |
| 490.00  | ft | 3628.44E-26 | 2892.97E-27 |
| 520.00  | ft | 4558.54E-25 | 3844.86E-26 |
| 550.00  | ft | 5051.91E-24 | 4606.22E-25 |
| 580.00  | ft | 5010.86E-23 | 4987.26E-24 |
| 610.00  | ft | 4339.67E-22 | 4696.40E-23 |
| 640.00  | ft | 3071.84E-21 | 3549.33E-22 |
| 670.00  | ft | 1609.71E-20 | 1937.49E-21 |
| 700.00  | ft | 5647.80E-20 | 6938.75E-21 |
| 730.00  | ft | 1232.21E-19 | 1526.51E-20 |
| 760.00  | ft | 1604.46E-19 | 1991.99E-20 |
| 790.00  | ft | 1230.27E-19 | 1524.90E-20 |
| 820.00  | ft | 5609.43E-20 | 6906.94E-21 |
| 850.00  | ft | 1567.58E-20 | 1902.58E-21 |
| 880.00  | ft | 2801.51E-21 | 3324.87E-22 |
| 910.00  | ft | 3307.95E-22 | 3837.26E-23 |
| 940.00  | ft | 2584.22E-23 | 2966.86E-24 |
| 970.00  | ft | 1306.21E-24 | 1515.76E-25 |
| 1000.00 | ft | 4188.88E-26 | 5025.52E-27 |
| 1030.00 | ft | 8518.67E-28 | 1079.10E-28 |
| 1060.00 | ft | 1121.10E-29 | 1528.80E-30 |

|         |    | 300.00 ft   | 330.00 ft   | 360.00 ft   | 390.00 ft   | 420.00 ft   |
|---------|----|-------------|-------------|-------------|-------------|-------------|
| 340.00  | ft | 2166.09E-24 | 1698.61E-24 | 1107.51E-24 | 6017.36E-25 | 2732.06E-25 |
| 370.00  | ft | 2395.59E-22 | 1847.41E-22 | 1183.33E-22 | 6306.91E-23 | 2802.87E-23 |
| 400.00  | ft | 1572.98E-20 | 1188.86E-20 | 7468.88E-21 | 3906.87E-21 | 1704.36E-21 |
| 430.00  | ft | 6145.82E-19 | 4521.69E-19 | 2772.91E-19 | 1419.95E-19 | 6080.21E-20 |
| 460.00  | ft | 1434.31E-17 | 1017.92E-17 | 6056.29E-18 | 3026.11E-18 | 1271.22E-18 |
| 490.00  | ft | 2001.85E-16 | 1357.35E-16 | 7797.57E-17 | 3798.62E-17 | 1569.66E-17 |
| 520.00  | ft | 1664.69E-15 | 1073.36E-15 | 5963.77E-16 | 2851.05E-16 | 1171.05E-16 |
| 550.00  | ft | 8231.35E-15 | 5102.10E-15 | 2784.92E-15 | 1331.78E-15 | 5559.34E-16 |
| 580.00  | ft | 2503.77E-14 | 1540.85E-14 | 8520.55E-15 | 4202.15E-15 | 1838.60E-15 |
| 610.00  | ft | 5237.98E-14 | 3315.29E-14 | 1916.66E-14 | 1003.85E-14 | 4732.27E-15 |
| 640.00  | ft | 8677.54E-14 | 5775.53E-14 | 3558.63E-14 | 2012.4CE-14 | 1036.31E-14 |
| 670.00  | ft | 1264.52E-13 | 8902.02E-14 | 5872.42E-14 | 3593.55E-14 | 2021.06E-14 |
| 700.00  | ft | 1718.48E-13 | 1271.20E-13 | 8905.57E-14 | 5839.72E-14 | 3543.09E-14 |
| 730.00  | ft | 2171.34E-13 | 1688.19E-13 | 1235.73E-13 | 8467.57E-14 | 5378.50E-14 |
| 760.00  | ft | 2653.23E-13 | 1950.26E-13 | 1407.03E-13 | 9679.53E-14 | 6225.25E-14 |
| 790.00  | ft | 1673.99E-13 | 1350.62E-13 | 1026.37E-13 | 7296.66E-14 | 4794.69E-14 |
| 820.00  | ft | 7717.73E-14 | 6382.60E-14 | 5012.84E-14 | 3667.6EE-14 | 2457.50E-14 |
| 850.00  | ft | 1709.99E-14 | 1705.35E-14 | 1499.61E-14 | 1175.54E-14 | 8201.44E-15 |
| 880.00  | ft | 2072.40E-15 | 2516.35E-15 | 2561.78E-15 | 2225.83E-15 | 1663.47E-15 |
| 910.00  | ft | 1653.27E-16 | 2292.38E-16 | 2618.40E-16 | 2495.74E-16 | 2001.54E-16 |
| 940.00  | ft | 8950.93E-18 | 1344.01E-17 | 1656.66E-17 | 1689.53E-17 | 1434.26E-17 |
| 970.00  | ft | 3196.83E-19 | 5030.90E-19 | 6506.00E-19 | 6945.67E-19 | 6145.77E-19 |
| 1000.00 | ft | 7269.54E-21 | 1176.87E-20 | 1568.79E-20 | 1726.61E-20 | 1572.98E-20 |
| 1030.00 | ft | 1023.48E-22 | 1686.52E-22 | 2292.78E-22 | 2575.86E-22 | 2395.59E-22 |
| 1060.00 | ft | 8750.25E-25 | 1458.94E-24 | 2010.42E-24 | 2292.47E-24 | 2166.09E-24 |

|         |    | 450.00 ft   | 480.00 ft   | 510.00 ft   | 540.00 ft   | 570.00 ft   |
|---------|----|-------------|-------------|-------------|-------------|-------------|
| 340.00  | ft | 1040.32E-25 | 3337.72E-26 | 9075.89E-27 | 2106.89E-27 | 4212.05E-28 |
| 370.00  | ft | 1041.38E-23 | 3245.98E-24 | 8527.80E-25 | 1899.94E-25 | 3617.70E-26 |
| 400.00  | ft | 6212.33E-22 | 1896.51E-22 | 4865.66E-23 | 1054.16E-23 | 1941.33E-24 |
| 430.00  | ft | 2179.83E-20 | 6553.25E-21 | 1655.84E-21 | 3529.06E-22 | 6378.04E-23 |
| 460.00  | ft | 4493.19E-19 | 1337.40E-19 | 3357.27E-20 | 7125.99E-21 | 1284.43E-21 |
| 490.00  | ft | 5502.18E-18 | 1636.64E-18 | 4134.83E-19 | 8890.28E-20 | 1632.60E-20 |
| 520.00  | ft | 4128.63E-17 | 1249.05E-17 | 3244.33E-18 | 7246.48E-19 | 1395.81E-19 |
| 550.00  | ft | 2021.14E-16 | 6392.77E-17 | 1758.95E-17 | 4213.10E-18 | 8798.00E-19 |
| 580.00  | ft | 7111.63E-16 | 2426.13E-16 | 7288.97E-17 | 1926.64E-17 | 4477.88E-18 |
| 610.00  | ft | 1997.56E-15 | 7518.43E-16 | 2514.37E-16 | 7449.28E-17 | 1950.16E-17 |
| 640.00  | ft | 4825.75E-15 | 2019.47E-15 | 7553.05E-16 | 2512.48E-16 | 7400.36E-17 |
| 670.00  | ft | 1035.57E-14 | 4794.44E-15 | 1990.25E-15 | 7354.79E-16 | 2403.27E-16 |
| 700.00  | ft | 1967.08E-14 | 9887.67E-15 | 4454.66E-15 | 1781.89E-15 | 6273.74E-16 |
| 730.00  | ft | 3130.48E-14 | 1649.70E-14 | 7780.28E-15 | 3248.61E-15 | 1189.37E-15 |
| 760.00  | ft | 3681.45E-14 | 1972.71E-14 | 9453.63E-15 | 4005.13E-15 | 1485.16E-15 |
| 790.00  | ft | 2873.54E-14 | 1550.74E-14 | 7449.15E-15 | 3152.97E-15 | 1165.65E-15 |
| 820.00  | ft | 1486.54E-14 | 8022.32E-15 | 3825.05E-15 | 1598.44E-15 | 5815.05E-16 |
| 850.00  | ft | 5061.62E-15 | 2744.42E-15 | 1299.18E-15 | 5342.14E-16 | 1900.06E-16 |
| 880.00  | ft | 1071.51E-15 | 5943.92E-16 | 2834.27E-16 | 1159.45E-16 | 4061.90E-17 |
| 910.00  | ft | 1356.83E-16 | 7791.70E-17 | 3793.47E-17 | 1565.99E-17 | 5480.56E-18 |
| 940.00  | ft | 1017.83E-17 | 6055.25E-18 | 3025.17E-18 | 1270.54E-18 | 4489.07E-19 |
| 970.00  | ft | 4521.60E-19 | 2772.80E-19 | 1419.85E-19 | 6079.45E-20 | 2179.37E-20 |
| 1000.00 | ft | 1188.86E-20 | 7468.82E-21 | 3906.81E-21 | 1704.32E-21 | 6212.03E-22 |
| 1030.00 | ft | 1847.41E-22 | 1183.32E-22 | 6306.89E-23 | 2802.85E-23 | 1041.37E-23 |
| 1060.00 | ft | 1698.61E-24 | 1107.51E-24 | 6017.35E-25 | 2732.05E-25 | 1040.32E-25 |

## I. HELP MODEL

UNC SITE SIMULATION  
USING A RCRA CAPA. SIMULATION INPUT

## LAYER 1

|                                    |                       |
|------------------------------------|-----------------------|
| VERTICAL PERCOLATION LAYER         |                       |
| ** THICKNESS                       | = 6.00 INCHES         |
| * EVAPORATION COEFFICIENT          | = 5.000 MM/DAY**0.5   |
| * POROSITY                         | = .5350 VOL/VOL       |
| * FIELD CAPACITY                   | = .4210 VOL/VOL       |
| * WILTING POINT                    | = .2220 VOL/VOL       |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = .33000000 INCHES/HR |

## LAYER 2

|                                    |                        |
|------------------------------------|------------------------|
| LATERAL DRAINAGE LAYER             |                        |
| ** SLOPE                           | = 3.00 PERCENT         |
| ** DRAINAGE LENGTH                 | = 120.0 FEET           |
| ** THICKNESS                       | = 12.00 INCHES         |
| * POROSITY                         | = .3890 VOL/VOL        |
| * FIELD CAPACITY                   | = .1990 VOL/VOL        |
| * WILTING POINT                    | = .0660 VOL/VOL        |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = 6.62000000 INCHES/HR |

## LAYER 3

|                                    |                       |
|------------------------------------|-----------------------|
| BARRIER SOIL LAYER WITH LINER      |                       |
| ** THICKNESS                       | = 24.00 INCHES        |
| * EVAPORATION COEFFICIENT          | = 3.100 MM/DAY**0.5   |
| * POROSITY                         | = .5177 VOL/VOL       |
| * FIELD CAPACITY                   | = .4202 VOL/VOL       |
| * WILTING POINT                    | = .3250 VOL/VOL       |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = .00325000 INCHES/HR |

\*DEFAULT DATA

\*\* USER SPECIFIED DATA

#### LAYER 4

|                                    |                         |
|------------------------------------|-------------------------|
| WASTE LAYER                        |                         |
| ** THICKNESS                       | = 180.00 INCHES         |
| * EVAPORATION COEFFICIENT          | = 3.300 MM/DAY**0.5     |
| * POROSITY                         | = .3510 VOL/VOL         |
| * FIELD CAPACITY                   | = .1740 VOL/VOL         |
| * WILTING POINT                    | = .1070 VOL/VOL         |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = 11.95000005 INCHES/HR |

#### LAYER 5

|                                    |                       |
|------------------------------------|-----------------------|
| VERTICAL PERCOLATION LAYER         |                       |
| ** THICKNESS                       | = 540.00 INCHES       |
| * EVAPORATION COEFFICIENT          | = 3.900 MM/DAY**0.5   |
| * POROSITY                         | = .5820 VOL/VOL       |
| * FIELD CAPACITY                   | = .4520 VOL/VOL       |
| * WILTING POINT                    | = .3250 VOL/VOL       |
| * EFFECTIVE HYDRAULIC CONDUCTIVITY | = .06500000 INCHES/HR |

#### GENERAL SIMULATION DATA

|                                     |                     |
|-------------------------------------|---------------------|
| * SCS RUNOFF CURVE NUMBER           | = 81.28             |
| ** TOTAL AREA OF COVER              | = 31000. SQ. FT     |
| ** EVAPORATIVE ZONE DEPTH           | = 6.00 INCHES       |
| ** LINER LEAKAGE FRACTION           | = .050000           |
| * EFFECTIVE EVAPORATION COEFFICIENT | = 5.000 MM/DAY**0.5 |
| * UPPER LIMIT VEG. STORAGE          | = 3.2100 INCHES     |
| * INITIAL VEG. STORAGE              | = 1.9290 INCHES     |

\* DEFAULT DATA

\*\* USER SPECIFIED DATA

CLIMATOLOGIC DATA

DEFAULT MONTHLY MEAN TEMPERATURES, DEGREES FAHRENHEIT

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---------|---------|---------|---------|---------|---------|
| 40.12   | 42.52   | 49.52   | 59.25   | 69.10   | 76.44   |
| 79.30   | 76.90   | 69.90   | 60.17   | 50.31   | 42.97   |

DEFAULT MONTHLY MEANS SOLAR RADIATION, LANGLEYS PER DAY

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---------|---------|---------|---------|---------|---------|
| 179.83  | 237.55  | 329.06  | 429.84  | 512.89  | 555.96  |
| 547.50  | 489.79  | 398.28  | 297.50  | 214.44  | 171.38  |

DEFAULT LEAF AREA INDEX TABLE

| DATE | LAI |
|------|-----|
| 1    | .00 |
| 91   | .00 |
| 113  | .61 |
| 135  | .99 |
| 157  | .99 |
| 179  | .99 |
| 201  | .99 |
| 223  | .99 |
| 245  | .89 |
| 267  | .65 |
| 289  | .32 |
| 311  | .16 |
| 366  | .00 |

USER SPECIFIED VEGITATIVE COVER = FAIR GRASS

DEFAULT WINTER COVER FACTOR = .60

B. SIMULATION OUTPUT

AVERAGE ANNUAL TOTALS

|                                   | (INCHES) | (CU. FT.) | PERCENT |
|-----------------------------------|----------|-----------|---------|
| PRECIPITATION                     | 52.30    | 135108.   | 100.00  |
| RUNOFF                            | 7.73     | 19991.    | 14.80   |
| EVAPOTRANSPIRATION                | 29.89    | 77236.    | 57.17   |
| PERCOLATION FROM BASE OF COVER    | 1.97     | 5097.     | 3.77    |
| PERCOLATION FROM BASE OF LANDFILL | 1.86     | 4809.     | 3.56    |
| DRAINAGE FROM BASE OF COVER       | 11.80    | 30495.    | 22.57   |

## II WATER BUDGET/SOURCE STRENGTH CALCULATIONS RCRA CAP ALTERNATIVE

### A. Water Budget Estimates for UNC Site (from HELP model, Section I.B. of UNC Site Simulation)

|                    | <u>Inches</u> | <u>Ft<sup>3</sup></u> |
|--------------------|---------------|-----------------------|
| Precipitation      | 52.3          | 135,000               |
| Runoff             | 7.7           | 19,991                |
| Evapotranspiration | 29.9          | 77,236                |
| Percolation        | 1.86          | 4,809                 |

### B. Source Strength/Inventory Calculations

1. Using data from 1986 Report (Table 8), for strontium in sludges/soils.

$$(6.2 \text{ dpm/g})(29,000 \text{ drums})(320 \text{ kg/drum})(10^3 \text{ g/kg})/(3.7 \times 10^{10} \text{ dps/Ci} \times 60 \text{ sec/min})$$

$$\begin{aligned} &= 0.026 \text{ Ci Sr-90} \\ &= 26 \text{ mCi Sr-90} \end{aligned}$$

$$\begin{aligned} \text{g: } (0.026 \text{ Ci})/(141 \text{ Ci/g}) &= 1.84 \times 10^{-4} \text{ g Sr-90} \\ \text{lb: } (1.84 \times 10^{-4} \text{ g})/(453.5924 \text{ g/lb}) &= 4.07 \times 10^{-7} \text{ lb Sr-90} \end{aligned}$$

2. Using data from 1986 Report (Table 8) for Sr-90 in EP-tox leachate:

$$(0.18 \text{ dpm/ml})(20 \text{ ml/g})(29,000 \text{ drums})(320 \text{ kg/drum})(10^3 \text{ g/kg})/(3.7 \times 10^{10} \text{ dps/Ci} \times 60 \text{ sec/min})$$

$$\begin{aligned} &= 0.015 \text{ Ci Sr-90} \\ &= 15 \text{ mCi Sr-90} \end{aligned}$$

$$\begin{aligned} \text{g: } (0.015 \text{ Ci})/(141 \text{ Ci/g}) &= 1.07 \times 10^{-4} \text{ g Sr-90} \\ \text{lb: } (1.07 \times 10^{-4} \text{ g})/(453.5924 \text{ g/lb}) &= 2.35 \times 10^{-7} \text{ lb Sr-90} \end{aligned}$$

Therefore, higher inventory estimate from B.1 will be used in subsequent calculations.

### C. Annual Sr-90 Released

Sr-90 concentration in infiltrating water:

$$\begin{aligned} (0.31 \text{ dpm/ml})/(3.7 \times 10^{10} \text{ dps/Ci} \times 60 \text{ sec/min}) &(10^3 \text{ ml/l})(28.32 \text{ l/ft}^3) \\ &= 3.95 \times 10^{-9} \text{ Ci/ft}^3 = 2.8 \times 10^{-11} \text{ g/ft}^3 \end{aligned}$$

Annual Release:

$$\begin{aligned} (4,800 \text{ ft}^3/\text{yr percolation}) &(2.8 \times 10^{-11} \text{ g/ft}^3) \\ &= 1.34 \times 10^{-7} \text{ g Sr-90 released/year} \\ &= 1.90 \times 10^{-5} \text{ Ci Sr-90 released/year} \end{aligned}$$

D. Annual Surface Runoff Sr-90 Local

Not applicable (no wastes exposed to potential surface runoff).

E. Annual Percolation Sr-90 Load

Equivalent to C, Annual Sr-90 Released:

$$= 1.34 \times 10^{-7} \text{ g Sr-90 released/year} = 3.67 \times 10^{-11} \text{ g/day}$$

$$= 1.90 \times 10^{-5} \text{ Ci Sr-90 released/year} = 5.21 \times 10^{-8} \text{ Ci/day}$$

F. Years required to release total inventory.

$$(26 \text{ mCi}) / (0.019 \text{ mCi/yr}) = 1368 \text{ years (no decay)}$$

G. Years Required to Reach Groundwater

For water:

$$(1.86 \text{ in/yr}) / (0.3 \text{ effective porosity}) = 6.2 \text{ in annual depth of infiltrate}$$

$$(45 \text{ ft soil thickness})(12 \text{ in/ft}) / (6.2 \text{ in/yr}) = 87 \text{ years}$$

For Sr-90:

Assuming Sr-90 Retardation Factor = 40

$$87 \text{ years} \times 40 = 3480 \text{ years}$$

(= 121 half-lives of Sr-90)

H. Source Strength Used for WMPLUME

Assuming 10 point sources spaced evenly over the UNC site:

$$3.67 \times 10^{-10} \text{ g/day} / 10 = 3.67 \times 10^{-11} \text{ g/day Sr-90}$$

$$5.21 \times 10^{-8} \text{ Ci/day} / 10 = 5.21 \times 10^{-9} \text{ Ci/day Sr-90}$$

$$8.1 \times 10^{-13} \text{ lb/day} / 10 = 8.1 \times 10^{-14} \text{ lbs/day Sr-90 per source.}$$

\*\*\*\*\*  
\* SOLUTE TRANSPORT FROM POINT SOURCES \*  
\* IN TWO-DIMENSIONAL UNIFORM FLOW \*  
\* MODEL: WMPLUME \*  
\*\*\*\*\*

USER:  
-----

LOCATION: RCRA Type Cap Alternative  
-----

DATE:  
-----

INPUT DATA:

|                                |       |      |
|--------------------------------|-------|------|
| DARCY VELOCITY.....            | 0.14  | ft/d |
| EFFECTIVE POROSITY.....        | .15   |      |
| AQUIFER THICKNESS.....         | 20.00 | ft   |
| LONGITUDINAL DISPERSIVITY..... | 12.00 | ft   |
| LATERAL DISPERSIVITY.....      | 4.00  | ft   |
| RETARDATION FACTOR.....        | 50.00 |      |
| DECAY CONSTANT (lambda).....   | .0001 | 1/d  |
| NUMBER OF POINT SOURCES.....   | 10    |      |

SOURCE DATA:

SOURCE NO. 1  
-----

|   |          |      |
|---|----------|------|
| X-COORDINATE OF THE SOURCE.....         | 40.00    | ft   |
| Y-COORDINATE OF THE SOURCE.....         | 640.00   | ft   |
| THE SOURCE STRENGTH.....                | 8.10E-14 | lb/d |
| ELAPSED TIME OF THE SOURCE ACTIVITY.... | 10950.00 | d    |

SOURCE NO. 2  
-----

|   |          |      |
|---|----------|------|
| X-COORDINATE OF THE SOURCE.....         | 80.00    | ft   |
| Y-COORDINATE OF THE SOURCE.....         | 600.00   | ft   |
| THE SOURCE STRENGTH.....                | 8.10E-14 | lb/d |
| ELAPSED TIME OF THE SOURCE ACTIVITY.... | 10950.00 | d    |

SOURCE NO. 3

---

X-COORDINATE OF THE SOURCE.....: 30.00 ft  
Y-COORDINATE OF THE SOURCE.....: 680.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 4

---

X-COORDINATE OF THE SOURCE.....: 120.00 ft  
Y-COORDINATE OF THE SOURCE.....: 640.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 5

---

X-COORDINATE OF THE SOURCE.....: 120.00 ft  
Y-COORDINATE OF THE SOURCE.....: 720.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 6

---

X-COORDINATE OF THE SOURCE.....: 160.00 ft  
Y-COORDINATE OF THE SOURCE.....: 680.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 7

---

X-COORDINATE OF THE SOURCE.....: 160.00 ft  
Y-COORDINATE OF THE SOURCE.....: 760.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 8

---

X-COORDINATE OF THE SOURCE.....: 200.00 ft  
Y-COORDINATE OF THE SOURCE.....: 720.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

SOURCE NO. 9

---

X-COORDINATE OF THE SOURCE.....: 200.00 ft  
Y-COORDINATE OF THE SOURCE.....: 800.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 lb/d  
ELAPSED TIME OF THE SOURCE ACTIVITY...:10950.00 d

X-COORDINATE OF THE SOURCE.....: 240.00 ft  
Y-COORDINATE OF THE SOURCE.....: 760.00 ft  
THE SOURCE STRENGTH.....: 8.10E-14 ib/c  
ELAPSED TIME OF THE SOURCE ACTIVITY....: 10950.00 d

GRID DATA:

X-COORDINATE OF THE GRID ORIGIN.....: 0.00 ft  
Y-COORDINATE OF THE GRID ORIGIN.....: 340.00 ft  
DISTANCE INCREMENT DELX.....: 30.00 ft  
DISTANCE INCREMENT DELY.....: 30.00 ft  
NUMBER OF NODES IN X-DIRECTION.....: 27  
NUMBER OF NODES IN Y-DIRECTION.....: 25

----- x-direction

## CONCENTRATION in mg/l ' ppm'

;  
v Y

|         |    | 0.00 ft  | 30.00 ft | 60.00 ft    | 90.00 ft    | 120.00 ft    |
|---------|----|----------|----------|-------------|-------------|--------------|
| 340.00  | ft | 0.00E+00 | 0.00E+00 | 2904.69E-30 | 2541.50E-27 | 7546.31E-27  |
| 370.00  | ft | 0.00E+00 | 0.00E+00 | 6767.49E-28 | 5031.29E-25 | 8969.93E-25  |
| 400.00  | ft | 0.00E+00 | 0.00E+00 | 9507.16E-26 | 2220.44E-23 | 6534.02E-23  |
| 430.00  | ft | 0.00E+00 | 0.00E+00 | 8127.72E-24 | 1028.06E-21 | 2996.46E-21  |
| 460.00  | ft | 0.00E+00 | 0.00E+00 | 4324.49E-22 | 150.24E-20  | 9026.31E-20  |
| 490.00  | ft | 0.00E+00 | 0.00E+00 | 1486.04E-20 | 5363.21E-19 | 1904.61E-18  |
| 520.00  | ft | 0.00E+00 | 0.00E+00 | 3503.14E-19 | 1178.78E-17 | 3068.14E-17  |
| 550.00  | ft | 0.00E+00 | 0.00E+00 | 6222.06E-18 | 1324.78E-16 | 4088.48E-16  |
| 580.00  | ft | 0.00E+00 | 0.00E+00 | 9452.27E-17 | 3086.66E-15 | 4123.06E-15  |
| 610.00  | ft | 0.00E+00 | 0.00E+00 | 1402.80E-15 | 1022.50E-14 | 9252.03E-15  |
| 640.00  | ft | 0.00E+00 | 0.00E+00 | 1245.84E-14 | 7586.06E-15 | -1000.00E-03 |
| 670.00  | ft | 0.00E+00 | 0.00E+00 | 1402.80E-15 | 1022.50E-14 | 9365.21E-15  |
| 700.00  | ft | 0.00E+00 | 0.00E+00 | 9452.27E-17 | 3086.66E-15 | 6196.23E-15  |
| 730.00  | ft | 0.00E+00 | 0.00E+00 | 6222.06E-18 | 1324.78E-16 | 7003.98E-15  |
| 760.00  | ft | 0.00E+00 | 0.00E+00 | 3503.14E-19 | 1178.78E-17 | 3188.03E-16  |
| 790.00  | ft | 0.00E+00 | 0.00E+00 | 1486.04E-20 | 5363.21E-19 | 2014.61E-17  |
| 820.00  | ft | 0.00E+00 | 0.00E+00 | 4324.49E-22 | 150.24E-20  | 1221.25E-18  |
| 850.00  | ft | 0.00E+00 | 0.00E+00 | 8127.72E-24 | 1028.06E-21 | 6108.94E-20  |
| 880.00  | ft | 0.00E+00 | 0.00E+00 | 9507.16E-26 | 2220.44E-23 | 2246.80E-21  |
| 910.00  | ft | 0.00E+00 | 0.00E+00 | 6767.49E-28 | 5031.29E-25 | 5592.10E-23  |
| 940.00  | ft | 0.00E+00 | 0.00E+00 | 2904.69E-30 | 2541.50E-27 | 8920.80E-25  |
| 970.00  | ft | 0.00E+00 | 0.00E+00 | 7595.92E-33 | 1288.66E-29 | 8814.99E-27  |
| 1000.00 | ft | 0.00E+00 | 0.00E+00 | 1257.05E-35 | 5959.62E-32 | 5287.82E-29  |
| 1030.00 | ft | 0.00E+00 | 0.00E+00 | 1408.22E-38 | 7579.05E-35 | 1916.45E-31  |
| 1060.00 | ft | 0.00E+00 | 0.00E+00 | 1167.72E-41 | 5573.14E-38 | 4273.16E-34  |

|         |    | 150.00 ft   | 180.00 ft   | 210.00 ft   | 240.00 ft    | 270.00 ft   |
|---------|----|-------------|-------------|-------------|--------------|-------------|
| 340.00  | ft | 1847.25E-26 | 3730.37E-26 | 6219.67E-26 | 9570.75E-26  | 9773.15E-26 |
| 370.00  | ft | 2181.15E-24 | 4363.23E-24 | 7189.90E-24 | 9774.48E-24  | 1098.13E-23 |
| 400.00  | ft | 1572.08E-22 | 3099.09E-22 | 5017.16E-22 | 6687.97E-22  | 7360.82E-22 |
| 430.00  | ft | 7081.92E-21 | 1362.81E-20 | 2144.71E-20 | 2773.58E-20  | 2961.04E-20 |
| 460.00  | ft | 2066.94E-19 | 3815.48E-19 | 5729.33E-19 | 7062.35E-19  | 7202.71E-19 |
| 490.00  | ft | 4112.36E-18 | 7045.63E-18 | 9770.55E-18 | 116.14E-17   | 1063.98E-17 |
| 520.00  | ft | 5903.70E-17 | 8826.36E-17 | 1072.05E-16 | 1091.76E-16  | 9489.97E-17 |
| 550.00  | ft | 6183.49E-16 | 7272.22E-16 | 7256.78E-16 | 5387.81E-16  | 5015.96E-16 |
| 580.00  | ft | 3805.35E-15 | 3268.38E-15 | 2707.27E-15 | 2135.36E-15  | 1574.31E-15 |
| 610.00  | ft | 8112.77E-15 | 6989.26E-15 | 5706.98E-15 | 4433.67E-15  | 3255.77E-15 |
| 640.00  | ft | 1514.77E-14 | 1106.78E-14 | 8761.19E-15 | 5888.86E-15  | 5194.37E-15 |
| 670.00  | ft | 8414.71E-15 | 1547.40E-14 | 1215.41E-14 | 447.89E-15   | 7263.93E-15 |
| 700.00  | ft | 7529.91E-15 | 1032.40E-14 | 1233.23E-14 | 156.73E-14   | 9462.93E-15 |
| 730.00  | ft | 7854.48E-15 | 7461.84E-15 | 1509.35E-14 | 320.68E-14   | 1122.45E-14 |
| 760.00  | ft | 7774.74E-16 | 1362.08E-14 | 8891.52E-15 | -1000.00E-03 | 1621.69E-14 |
| 790.00  | ft | 5661.97E-17 | 1516.69E-15 | 1039.73E-14 | 9461.32E-15  | 8326.03E-15 |
| 820.00  | ft | 3632.66E-18 | 1028.37E-16 | 3101.48E-15 | 4144.22E-15  | 3830.16E-15 |
| 850.00  | ft | 1870.53E-19 | 6677.87E-18 | 1833.64E-16 | 4102.41E-16  | 6201.40E-16 |
| 880.00  | ft | 6989.63E-21 | 3679.11E-19 | 1182.37E-17 | 3074.10E-17  | 5911.81E-17 |
| 910.00  | ft | 1755.17E-22 | 1531.03E-20 | 6872.63E-19 | 1906.22E-18  | 4114.63E-18 |
| 940.00  | ft | 2814.14E-24 | 4397.38E-22 | 3151.79E-20 | 9029.02E-20  | 2067.33E-19 |
| 970.00  | ft | 2789.01E-26 | 8200.42E-24 | 1028.21E-21 | 2996.74E-21  | 7082.33E-21 |
| 1000.00 | ft | 1676.15E-28 | 9551.04E-26 | 2220.53E-23 | 6534.19E-23  | 1572.10E-22 |
| 1030.00 | ft | 6083.52E-31 | 6783.48E-28 | 3031.32E-25 | 5970.00E-25  | 2181.16E-24 |

|         |    | 300.00 ft   | 330.00 ft   | 360.00 ft   | 390.00 ft   | 420.00 ft   |
|---------|----|-------------|-------------|-------------|-------------|-------------|
| 340.00  | ft | 9234.39E-26 | 7241.43E-26 | 4721.47E-26 | 2565.29E-26 | 1164.72E-26 |
| 370.00  | ft | 1021.28E-23 | 7875.50E-24 | 5044.70E-24 | 2688.74E-24 | 1194.91E-24 |
| 400.00  | ft | 6705.87E-22 | 5068.31E-22 | 3184.10E-22 | 1665.56E-22 | 7265.98E-23 |
| 430.00  | ft | 2620.06E-20 | 1927.67E-20 | 1182.14E-20 | 6053.49E-21 | 2592.09E-21 |
| 460.00  | ft | 6114.67E-19 | 4339.56E-19 | 2581.89E-19 | 1290.08E-19 | 5419.43E-20 |
| 490.00  | ft | 8534.22E-18 | 5786.59E-18 | 3324.23E-18 | 1619.41E-18 | 6691.71E-19 |
| 520.00  | ft | 7096.85E-17 | 4575.92E-17 | 2542.45E-17 | 1215.45E-17 | 4992.36E-18 |
| 550.00  | ft | 3509.15E-16 | 2175.11E-16 | 1187.25E-16 | 5677.61E-17 | 2370.04E-17 |
| 580.00  | ft | 1067.40E-15 | 6568.90E-16 | 3632.44E-16 | 1791.44E-16 | 7838.22E-17 |
| 610.00  | ft | 2233.04E-15 | 1413.36E-15 | 8171.02E-16 | 4279.56E-16 | 2017.44E-16 |
| 640.00  | ft | 3699.37E-15 | 2462.20E-15 | 1517.10E-15 | 8579.19E-16 | 4417.96E-16 |
| 670.00  | ft | 5390.84E-15 | 3795.07E-15 | 2503.51E-15 | 1531.99E-15 | 8616.08E-16 |
| 700.00  | ft | 7326.16E-15 | 5417.32E-15 | 3796.59E-15 | 2489.56E-15 | 1510.48E-15 |
| 730.00  | ft | 9256.75E-15 | 7197.00E-15 | 5268.11E-15 | 3609.86E-15 | 2292.94E-15 |
| 760.00  | ft | 1131.11E-14 | 8314.25E-15 | 5998.37E-15 | 4126.54E-15 | 2653.92E-15 |
| 790.00  | ft | 7136.47E-15 | 5757.92E-15 | 4375.58E-15 | 3110.68E-15 | 2044.05E-15 |
| 820.00  | ft | 3290.19E-15 | 2721.00E-15 | 2137.05E-15 | 1563.59E-15 | 1047.67E-15 |
| 850.00  | ft | 7289.97E-16 | 7270.19E-16 | 6393.07E-16 | 5011.51E-16 | 3496.40E-16 |
| 880.00  | ft | 8834.97E-17 | 1072.76E-16 | 1092.13E-16 | 9489.05E-17 | 7091.65E-17 |
| 910.00  | ft | 7048.15E-18 | 9772.76E-18 | 1116.26E-17 | 1063.98E-17 | 8532.89E-18 |
| 940.00  | ft | 3815.92E-19 | 5729.73E-19 | 7062.60E-19 | 7202.73E-19 | 6114.46E-19 |
| 970.00  | ft | 1362.86E-20 | 2144.75E-20 | 2773.61E-20 | 2961.05E-20 | 2620.04E-20 |
| 1000.00 | ft | 3099.12E-22 | 5017.19E-22 | 6687.99E-22 | 7360.83E-22 | 6705.86E-22 |
| 1030.00 | ft | 4363.24E-24 | 7189.91E-24 | 9774.49E-24 | 1098.13E-23 | 1021.28E-23 |
| 1060.00 | ft | 3730.37E-26 | 6219.67E-26 | 8570.75E-26 | 9773.15E-26 | 9234.38E-26 |

|         |    | 450.00 ft   | 480.00 ft   | 510.00 ft   | 540.00 ft   | 570.00 ft   |
|---------|----|-------------|-------------|-------------|-------------|-------------|
| 340.00  | ft | 4435.04E-27 | 1422.92E-27 | 3869.19E-28 | 8982.00E-29 | 1795.66E-29 |
| 370.00  | ft | 4439.56E-25 | 1383.81E-25 | 3635.54E-26 | 8099.74E-27 | 1542.28E-27 |
| 400.00  | ft | 2648.42E-23 | 8085.13E-24 | 2074.31E-24 | 4494.05E-25 | 8276.21E-26 |
| 430.00  | ft | 9292.95E-22 | 2793.76E-22 | 7059.11E-23 | 1504.50E-23 | 2719.06E-24 |
| 460.00  | ft | 1915.52E-20 | 5701.56E-21 | 1431.26E-21 | 3037.92E-22 | 5475.71E-23 |
| 490.00  | ft | 2345.67E-19 | 6977.24E-20 | 1762.74E-20 | 3790.07E-21 | 6960.01E-22 |
| 520.00  | ft | 1760.10E-18 | 5324.89E-19 | 1383.11E-19 | 3089.29E-20 | 5950.55E-21 |
| 550.00  | ft | 8616.45E-18 | 2725.34E-18 | 7498.69E-19 | 1796.11E-19 | 3750.72E-20 |
| 580.00  | ft | 3031.80E-17 | 1034.30E-17 | 3107.40E-18 | 8213.58E-19 | 1908.99E-19 |
| 610.00  | ft | 8515.93E-17 | 3205.22E-17 | 1071.92E-17 | 3175.75E-18 | 8313.86E-19 |
| 640.00  | ft | 2057.29E-16 | 8607.32E-17 | 3219.98E-17 | 1071.11E-17 | 3154.89E-18 |
| 670.00  | ft | 4414.78E-16 | 2043.95E-16 | 8484.75E-17 | 3135.46E-17 | 1024.55E-17 |
| 700.00  | ft | 8385.95E-16 | 4215.27E-16 | 1899.09E-16 | 7596.50E-17 | 2674.59E-17 |
| 730.00  | ft | 1334.57E-15 | 7032.92E-16 | 3316.85E-16 | 1384.93E-16 | 5070.45E-17 |
| 760.00  | ft | 1569.46E-15 | 8409.97E-16 | 4030.23E-16 | 1707.45E-16 | 6331.48E-17 |
| 790.00  | ft | 1225.04E-15 | 6611.03E-16 | 3175.69E-16 | 1344.16E-16 | 4969.35E-17 |
| 820.00  | ft | 6337.34E-16 | 3420.04E-16 | 1630.68E-16 | 6814.40E-17 | 2479.05E-17 |
| 850.00  | ft | 2157.85E-16 | 1169.99E-16 | 5538.62E-17 | 2277.44E-17 | 8100.27E-18 |
| 880.00  | ft | 4568.00E-17 | 2533.99E-17 | 1208.30E-17 | 4942.84E-18 | 1731.65E-18 |
| 910.00  | ft | 5784.36E-18 | 3321.73E-18 | 1617.22E-18 | 6676.07E-19 | 2336.45E-19 |
| 940.00  | ft | 4339.18E-19 | 2581.45E-19 | 1289.68E-19 | 5416.52E-20 | 1913.76E-20 |
| 970.00  | ft | 1927.63E-20 | 1182.09E-20 | 6053.06E-21 | 2591.77E-21 | 9290.99E-22 |
| 1000.00 | ft | 5068.28E-22 | 3184.07E-22 | 1665.53E-22 | 7265.77E-23 | 2648.28E-23 |
| 1030.00 | ft | 7875.79E-24 | 5044.69E-24 | 2688.73E-24 | 1194.90E-24 | 4439.50E-25 |
| 1060.00 | ft | 7241.42E-26 | 4721.47E-26 | 2565.29E-26 | 1164.72E-26 | 4435.03E-27 |

|         |    | 600.00 ft   | 630.00 ft   | 660.00 ft   | 690.00 ft   | 720.00 ft   |
|---------|----|-------------|-------------|-------------|-------------|-------------|
| 340.00  | ft | 5123.09E-30 | 4779.88E-31 | 6518.58E-32 | 8026.34E-33 | 9045.19E-34 |
| 370.00  | ft | 2533.93E-28 | 3632.80E-29 | 4602.87E-30 | 5226.14E-31 | 5395.56E-32 |
| 400.00  | ft | 1306.74E-26 | 1787.87E-27 | 2146.62E-28 | 2294.11E-29 | 2216.00E-30 |
| 430.00  | ft | 4198.50E-25 | 5593.66E-26 | 6508.82E-27 | 6709.47E-28 | 6223.57E-29 |
| 460.00  | ft | 8435.60E-24 | 1120.72E-24 | 1298.81E-25 | 1330.99E-26 | 1224.60E-27 |
| 490.00  | ft | 1097.75E-22 | 1498.76E-23 | 1789.32E-24 | 1890.72E-25 | 1792.46E-26 |
| 520.00  | ft | 9927.92E-22 | 1443.40E-22 | 1842.92E-23 | 2085.69E-24 | 2114.66E-25 |
| 550.00  | ft | 5844.75E-21 | 1095.26E-21 | 1543.61E-22 | 1927.34E-23 | 2147.44E-24 |
| 580.00  | ft | 3900.96E-20 | 7012.57E-21 | 1110.64E-21 | 1553.97E-22 | 1928.87E-23 |
| 610.00  | ft | 1919.11E-19 | 3899.67E-20 | 6968.84E-21 | 1095.16E-21 | 1515.14E-22 |
| 640.00  | ft | 8194.52E-19 | 1869.74E-19 | 3734.65E-20 | 6511.74E-21 | 9893.57E-22 |
| 670.00  | ft | 2941.56E-18 | 7376.32E-19 | 1606.77E-19 | 3026.32E-20 | 4912.35E-21 |
| 700.00  | ft | 8223.80E-18 | 2192.90E-18 | 5040.39E-19 | 9936.71E-20 | 1674.34E-20 |
| 730.00  | ft | 1614.06E-17 | 4435.26E-18 | 1045.74E-18 | 2105.43E-19 | 3607.55E-20 |
| 760.00  | ft | 2037.60E-17 | 5650.58E-18 | 1342.37E-18 | 2719.15E-19 | 4681.20E-20 |
| 790.00  | ft | 1592.63E-17 | 4396.59E-18 | 1039.80E-18 | 2097.68E-19 | 3598.92E-20 |
| 820.00  | ft | 7806.33E-18 | 2117.08E-18 | 4923.45E-19 | 9783.55E-20 | 1657.25E-20 |
| 850.00  | ft | 2483.47E-18 | 6544.02E-19 | 1478.38E-19 | 2858.12E-20 | 4724.64E-21 |
| 880.00  | ft | 5188.44E-19 | 1328.34E-19 | 2904.99E-20 | 5429.73E-21 | 8688.91E-22 |
| 910.00  | ft | 6932.09E-20 | 1744.29E-20 | 3727.03E-21 | 6779.50E-22 | 1054.27E-22 |
| 940.00  | ft | 5692.81E-21 | 1427.61E-21 | 3025.24E-22 | 5438.69E-23 | 8344.49E-24 |
| 970.00  | ft | 2792.75E-22 | 7054.86E-23 | 1502.98E-23 | 2714.52E-24 | 4186.95E-25 |
| 1000.00 | ft | 6084.45E-24 | 2074.01E-24 | 4492.95E-25 | 8272.78E-26 | 1305.83E-26 |
| 1030.00 | ft | 1383.78E-25 | 3635.40E-26 | 8099.23E-27 | 1542.12E-27 | 2533.47E-28 |
| 1060.00 | ft | 1422.92E-27 | 3869.16E-28 | 8981.84E-29 | 1795.61E-29 | 3122.92E-30 |

|         |    | 750.00 ft   | 780.00 ft   |
|---------|----|-------------|-------------|
| 340.00  | ft | 9457.19E-35 | 9296.07E-36 |
| 370.00  | ft | 5140.98E-33 | 4587.54E-34 |
| 400.00  | ft | 1965.75E-31 | 1626.95E-32 |
| 430.00  | ft | 5280.80E-30 | 4167.53E-31 |
| 460.00  | ft | 1028.06E-28 | 8004.56E-30 |
| 490.00  | ft | 1546.86E-27 | 1233.32E-28 |
| 520.00  | ft | 1943.38E-26 | 1639.12E-27 |
| 550.00  | ft | 2153.71E-25 | 1963.71E-26 |
| 580.00  | ft | 2136.21E-24 | 2126.15E-25 |
| 610.00  | ft | 1850.07E-23 | 2002.15E-24 |
| 640.00  | ft | 1309.57E-22 | 1513.13E-23 |
| 670.00  | ft | 6862.44E-22 | 8259.83E-23 |
| 700.00  | ft | 2407.75E-21 | 2958.10E-22 |
| 730.00  | ft | 5253.11E-21 | 6507.75E-22 |
| 760.00  | ft | 6840.05E-21 | 8492.15E-22 |
| 790.00  | ft | 5244.85E-21 | 6500.88E-22 |
| 820.00  | ft | 2391.39E-21 | 2944.54E-22 |
| 850.00  | ft | 6682.83E-22 | 8111.00E-23 |
| 880.00  | ft | 1194.33E-22 | 1417.44E-23 |
| 910.00  | ft | 1410.23E-23 | 1635.89E-24 |
| 940.00  | ft | 1101.70E-24 | 1264.82E-25 |
| 970.00  | ft | 5568.59E-26 | 6461.93E-27 |
| 1000.00 | ft | 1785.78E-27 | 2142.46E-28 |
| 1030.00 | ft | 3631.64E-29 | 4600.39E-30 |
| 1060.00 | ft | 4779.43E-31 | 6517.53E-32 |